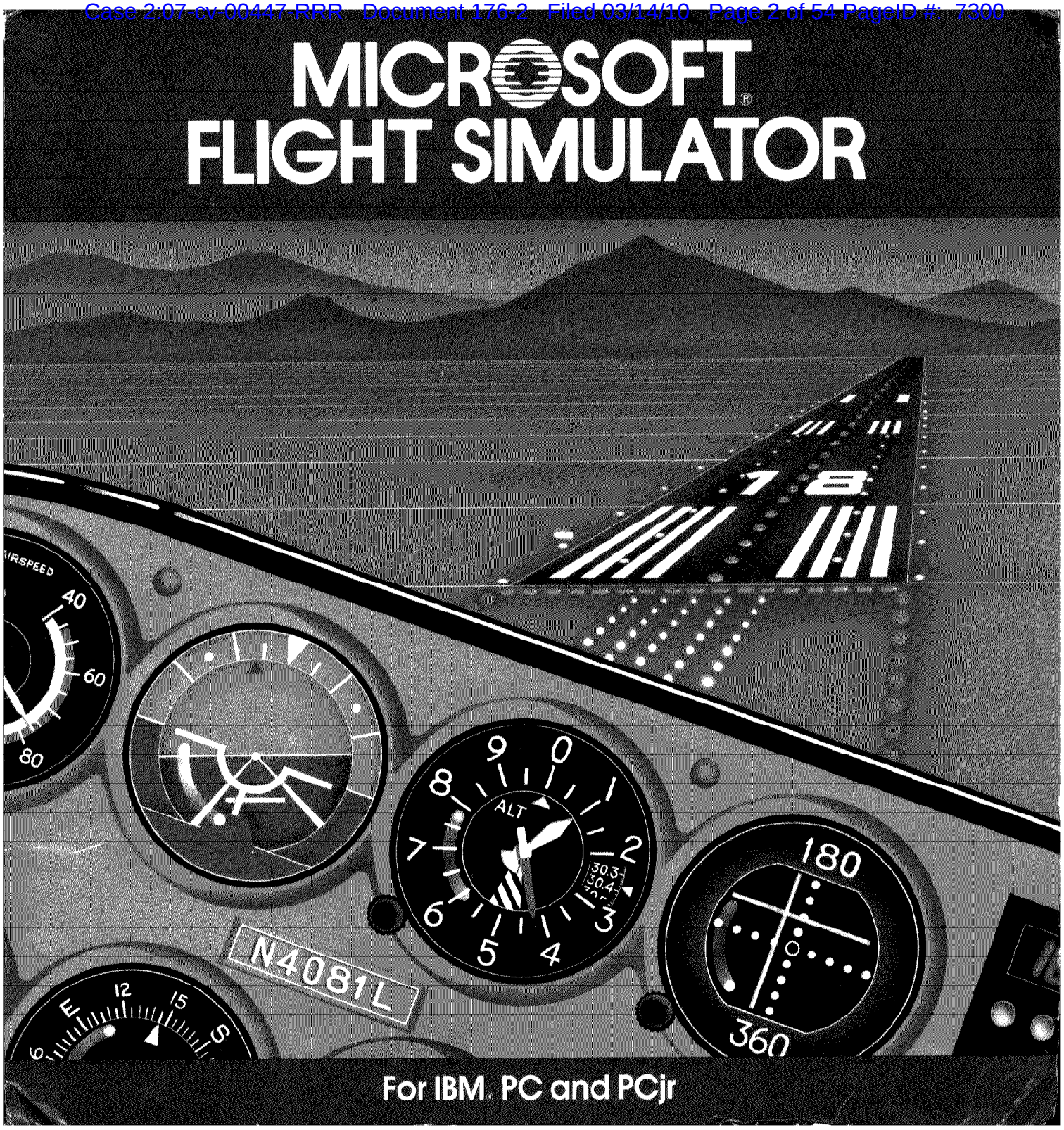
EXHIBIT B

MICROSOFT® FLIGHT SIMULATOR



For IBM® PC and PCjr

Microsoft® Flight Simulator®

Information Manual and Flight Handbook

for IBM® Personal Computers

Microsoft Corporation

If you have comments about this documentation or the enclosed software, complete the Software Problem Report at the back of this manual and return it to Microsoft.

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Table of Contents

Learning Flight Simulator

Before you use Flight Simulator, you should be familiar with certain basics. That's what this chapter covers, including a "flying start" procedure for those who want to get off the ground even before reading this manual.

To introduce you to Flight Simulator, this chapter describes:

- The three-dimensional display where you'll be able to view your surroundings from all directions.
- Flight instruments you use to control your flight.
- Radios for communicating with the airports where you'll land and take off.
- Indicators on the control panel to help you monitor your flight.

Exactly how you use your aircraft controls depends on whether you're using an IBM® PCjr or an IBM PC or PC XT. A lot of controls are similar, but there are some differences. To make learning as easy as possible, you'll find two sections about the controls – one section for the PCjr and the other for the IBM PC and PC XT.

Introduction

Microsoft® Flight Simulator is a second-generation, real-time flight simulation program for microcomputers. The simulation considers 35 important aircraft characteristics, and includes an out-the-window three-dimensional dynamic flight display, extensive flight controls, and minimum Visual Flight Rule (VFR) and Instrument Flight Rule (IFR) instrumentation as specified by the Federal Aviation Administration (FAA).

Unlike first-generation simulators, Flight Simulator features detailed graphics that closely simulate a pilot's actual perspective. Flight instruments look and behave like the real thing. The "world" is more than 10,000 by 10,000 miles square with a resolution of approximately 2.5 inches.

The world encompasses the entire continental United States and extends into Canada, Mexico, and the Caribbean. The "populated" world consists of four areas and includes more than 20 airports detailed in charts at the back of this manual. Winds, clouds, time of day (for dawn, day, dusk, and night flight), and navigation aids are also included.

The added features make the aircraft more difficult to fly than first-generation simulators, so as a convenience to new pilots, two distinct flight modes are provided. If you have never flown before, you can use "easy flight mode" to learn the fundamentals of flight control. In easy flight mode, you fly in optimal conditions and use only the primary flight instruments and controls.

When you have mastered the basics of flight, or if you are already a seasoned pilot, you can select "reality flight mode" to simulate more sophisticated flight factors.

In either mode, you can add environmental conditions, such as wind, time of day, and turbulence. You can also set a reliability factor that determines the frequency with which flight problems arise. You can even set up test situations.

Flight Simulator is modeled after the performance characteristics of an aircraft of the Cessna 182 class (single engine, land, with substantial performance). It is an ideal plane for pilot training because it has climb performance and speed that keep a pilot busy, especially on landing approach. The plane is slightly superior to an advanced World War I fighter.

Flight Simulator can provide hours of rewarding entertainment. In addition to the easy and realistic simulation modes, it includes the WWI Ace war game, which lets you test your dogfighting and bombing skills.

Flight Simulator will help you learn about flight. It is not, however, a substitute for a flight training course. If you want more information on learning to fly, we recommend that you read the *Flight Training Handbook* published by the FAA, or check with your local airport for information about certified flight training courses.

About This Manual

Because Flight Simulator is a program that will be enjoyed by novices and seasoned pilots alike, this manual begins with an introduction to flight procedures, operations, and control.

For novice pilots:

If you are new to flying, we recommend that you work through the manual. If you have a PCjr, you should read "Aircraft Controls for the PCjr." If you have a PC, you should read "Aircraft Controls for the PC." Both chapters are identical except for specific keystrokes you'll use to fly. The remainder of the manual is designed with both PCjr and PC users in mind.

For experienced pilots:

If you are an experienced pilot, you may want to learn how to operate the instruments and controls and then proceed directly to the section entitled "The Editor." You can use the editor to set environmental and flight conditions. You can also use the editor to shift from one of the four Flight Simulator geographic areas to another. (These areas are mapped, for use with Flight Simulator only, in Reference Charts at the back of the manual. Diagrams of airports also can be found there.) After you are familiar with the editor, proceed to "Advanced Flight Techniques."

This manual explains how to use Flight Simulator and covers some basic flight techniques. Flight instruction is beyond the scope of this manual. If you would like further information on flying, we recommend you read any of the following, available at FBOs (Fixed Base Operators) or flight training schools at most airports:

To learn about flying:

- *Flight Training Handbook*. U.S. Department of Transportation, Federal Aviation Administration.
- *Aviation Fundamentals*. 6th ed. Jeppesen Sanderson, Inc.
- *Instrument Flying Handbook*. U.S. Department of Transportation, Federal Aviation Administration.

Other publications:

- *Airman's Information Manual*. Aero Publishers, Inc.
- Chicago Sectional Aeronautical Chart
- Los Angeles Sectional Aeronautical Chart
- New York Sectional Aeronautical Chart
- Seattle Sectional Aeronautical Chart

Any of these publications can also be ordered directly from Sporty's Pilot Shop, Clermont County Airport, Batavia, Ohio 45103, (513) 732-2411.

If you're impatient: Learning to fly is not easy. But if you're eager to get started immediately before reading this manual, skip to the "Flying Start" procedures at the end of this introduction.

Note Terms italicized in the text are defined in the Glossary. Single characters are italicized when they represent keys you should press.

About the Designer

Flight Simulator was written by Bruce A. Artwick, President of Sublogic Company, Champaign, Illinois, a hardware and software firm specializing in high performance graphics systems. Mr. Artwick gained extensive experience in high performance signal processor architecture design and microcomputer-based radar control systems at Hughes Aircraft Company. In addition, he has performed research in minicomputer- and microcomputer-based graphics system design at the Aviation Research Laboratory and Digital Computer Laboratories, University of Illinois, where he received a BS and MS in electrical engineering.

Using Flight Simulator With the IBM PCjr and PC

The program disk contains two versions of Flight Simulator: one for use on the IBM PCjr and the other for use on the PC (or PC XT). A small startup program automatically determines which machine is being used and loads the proper version of Flight Simulator.

The PCjr and PC versions are functionally the same. Different keys are used for the controls due to keyboard differences. You will find that the third and fourth chapters, "Aircraft Controls for the PCjr" and "Aircraft Controls for the PC," are identical except for the keys that you use. Other chapters of this manual will specify wherever keys differ.

Reference Figures 2 and 3 at the back of this manual show the keyboard controls for the PCjr and PC. These figures are convenient references when reading this manual and flying the simulator.

Using the Shift Key on the PCjr

Activating most controls on the PCjr (radios, lights, and instrument knobs) entails holding down the Shift key while pressing the appropriate key. This manual notes such commands by preceding them with Shift; for example, to turn on the instrument panel lights, press Shift *L*.

In this example, type *L* on the PCjr by holding down the Shift key while pressing *L* as you would on any computer terminal or typewriter.

The Caps Lock key has no effect. Pressing Caps Lock will not hold down the Shift key or affect program operation in any way.

Using the PCjr Keyboard

The PCjr keyboard does not include a three-by-three numeric keypad. But many directional functions (flight direction control, view direction control, and slew control) use the keypad concept for "pointing" (see Figure 1). A three-by-three section of the PCjr keyboard has, therefore, been defined as a three-by-three keypad.

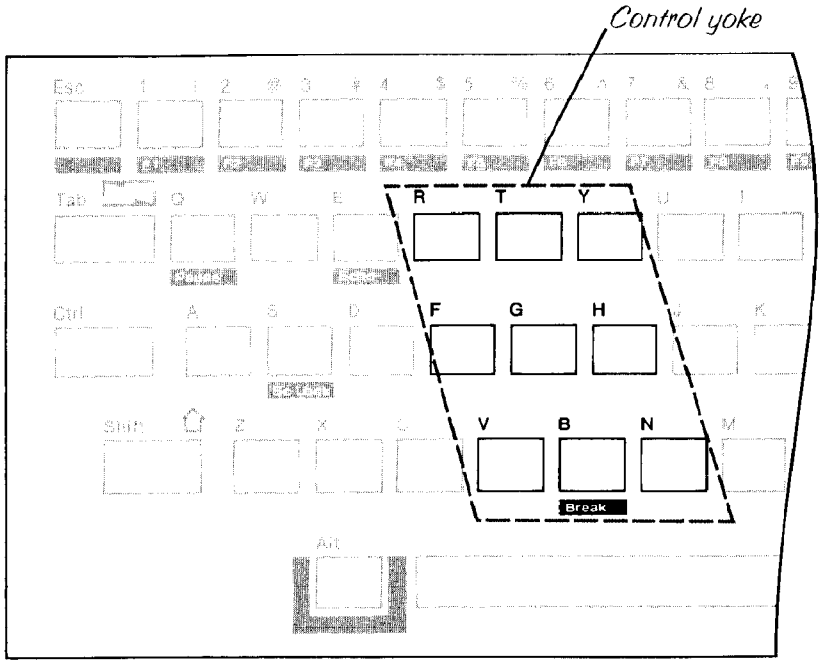

Figure 1. Control Yoke for the PCjr

As long as you remember that G is the keypad's center, that the bracket keys ([ ]) are the throttle controls, the 4 and 5 keys are the radar and view selectors, and the period key (.) is the brakes, you are well on your way to flying successfully. Using these keys for the directional functions does not require holding down the Shift key.

All the radio and instrument controls can be remembered by the first letter that appears on the instrument panel (N is for NAV, C is for COM) or on the instrument knob (V adjusts the VOR, D the directional gyro). Also remember that Shift must be pressed for all control panel functions.

System Requirements

For the IBM PCjr, you'll need:

- IBM PCjr with at least 128K bytes of memory.
- A color television or a color composite, black and white, or RGB monitor.
- A disk drive.
- Optional: one or two joysticks.
- Optional: Microsoft Mouse.
- Enclosed but optional: Flight Simulator keyboard overlay.

For the IBM PC or PC XT you'll need:

- IBM PC with at least 64K bytes of memory.
- IBM Color/Graphics monitor adapter.
- A color television or a color composite, black and white, or RGB monitor.
- At least one disk drive (single or double sided).
- Optional: one or two joysticks and an IBM Game Control Adapter Card.
- Optional: Microsoft Mouse. (A total of 128K bytes of memory is required if the mouse is used.)

Flight Simulator will work with any monitor type. A color composite monitor or color television yields excellent results (15 colors). If you use an RGB monitor with the PC or PC XT, you will get only four colors and four shaded tones. When you load the Flight Simulator, the program will ask what kind of monitor you have and will make the best use of that monitor.

The entire Flight Simulator program is contained on the disk you received in this package. You will need an additional disk to create a backup of your disk and a third disk for saving simulation data.

How to Load Flight Simulator

To load Flight Simulator, follow this procedure:

- Open the door of disk drive A.
- Remove the Flight Simulator disk from its protective jacket.
- Holding the labeled end of the disk, insert it into the drive with the label facing up. When the disk is in as far as it will go, close the disk drive door.
- If your computer is off, turn on the System Unit Switch and monitor. If the computer is already on, press the Del key while holding down the Ctrl and Alt keys.

To identify your display:

- The disk will whirr from five seconds to several minutes, the light on your disk drive will come on, and a few seconds later the following will appear on your screen:

```
MICROSOFT FLIGHT SIMULATOR
VERSION 2.1
COPYRIGHT BY BRUCE A. ARTWICK, 1984
PRODUCED BY MICROSOFT CORPORATION

WHAT DISPLAY ARE YOU USING?

A. COLOR TV OR COLOR COMPOSITE MONITOR
B. BLACK AND WHITE TV OR MONITOR
C. RGB MONITOR

(TYPE A, B, OR C)
```

Answer by typing the appropriate letter.

To choose a mode:

- The second adjustment screen will ask:

```
SELECT MODE OF OPERATION

A. DEMO MODE
B. REGULAR FLIGHT MODE
C. DISK BACKUP

(TYPE A, B, OR C)
```

Choosing option A begins a demonstration in which the plane flies itself. Choosing option B begins the program in "easy flight mode."

If this is the first time you are using the Flight Simulator program, select option C to make a backup copy of the program. Proceed to the next section, "How to Back Up Your Flight Simulator Disk."

To identify your keyboard:

▶ If you selected demo or regular flight mode, the third menu screen will ask what kind of keyboard you have:


```
SELECT KEYBOARD MODE

A.  IBM PC JUNIOR KEYBOARD
B.  IBM PC TYPE KEYBOARD

(TYPE A OR B)
```

If you are using the PCjr keyboard, type *A*. If you are using a keyboard with a full set of 83 keys (numeric keypad and two rows of function keys as on the IBM PC or PC XT), type *B*.

The instrument panel will flash onto the screen. Use the Tab key to center the display on your screen. You can use this key at any time during flight to move the display to the right. When it has gone as far right as it can go, the display will shift full left.

If you chose the demo option mode, relax and enjoy the show. To end the demonstration, press Esc. This will put you in the editor, where you can select regular flight mode. To do so, press the Enter key to move the arrow to the User Mode parameter, and enter *0*.

If you chose regular flight mode, proceed to the instructional part of the manual.

How to Back Up Your Flight Simulator Disk

With Flight Simulator, you can make a single copy of the program for backup purposes. This copy should be used for backup purposes only. Any other use of the extra copy is a violation of copyright laws.

To back up your Flight Simulator disk, follow these instructions:

- Load the program, using the instructions in "How to Load Flight Simulator." Select option C when the option menu appears at the beginning of the program. The program will tell you to:

  REMOVE THE MASTER DISK FROM DRIVE A:
  AND INSERT COPY DISK INTO DRIVE A:.

  HIT ANY KEY WHEN READY.

- Insert a blank disk. (Make sure it does not have a write-protect tab on it.) After a few moments, you will be instructed to:

  REMOVE THE COPY DISK AND INSERT
  THE MASTER DISK INTO DRIVE A:.

  HIT ANY KEY WHEN READY.

- As prompted, switch disks during the copying process. When the copying process is finished, the program will say:

  COPYING DONE. REBOOT THE SYSTEM
  TO GET GOING AGAIN.

- Place a write-protect tab on your master disk, and store it in a safe place. Place a write-protect tab on your backup copy, and use it to reload the program, as detailed in "How to Load Flight Simulator."

Note After making a backup copy of your Flight Simulator disk, leave the write-protect tabs on both disks.

Flying Start

You've got a PCjr, and you're eager for your first flight – even before you read this manual. To get flying now, just follow this procedure. You'll get an idea of what the Flight Simulator is all about.

A quick test flight for the PCjr:

- Boot the disk as you would any system master disk.
- When the instrument panel and startup menu appear, press the *A* key if you have a color monitor, *B* if you have a monochrome monitor, or *C* if you have an RGB monitor.
- On the second startup menu, press *B* to continue this test flight (pressing *A* will start an automatic demo – reboot to get out of it).
- On the third startup menu, press *A* to select the PCjr keyboard. You'll be on Meigs Field in Chicago (a small airport on a peninsula, surrounded by Lake Michigan).
- Press *5*, then *F*, to look out the left side of the airplane. Notice the wing at the top of the three-dimensional display.
- Press *5*, then *B*, to look out the back of the plane. Notice the tail at the screen's center.
- Press *5*, then *T*, to return to a forward view.
- Press *B* four times in rapid succession (no more than 1/2 second between keypresses). This raises the elevator a bit.
- Press the] key 32 times. This increases throttle to full so the plane starts rolling down the runway. The plane will take off by itself. You'll be able to see when you leave the ground.
- Once off the ground, press *5*, then *B*, to look out the back again.
- Press *5*, then *T*, for the front view. Watch the flight instruments. Airspeed, altimeter, and vertical velocity gauges will all show movement.
- Press *F* to start banking the plane. The horizon will tilt. Don't let the bank get too steep.
- After about 20 degrees of bank, press *G* to neutralize the ailerons and keep the plane in its current bank.
- Press Esc. On the menu that appears, you can adjust flight parameters. Press the Enter key many times. The arrow will sequence through two pages of 40 adjustable parameters. After looking them over, press Esc again to get back into flight mode.
- Now press *H* six times, and wait about a minute without interfering with the controls.
- After a crash, Flight Simulator resets and returns you to your starting location.

You've got a PC or a PC XT, and you're eager for your first flight – even before you read this manual. To get flying now, just follow this procedure. You'll get an idea of what the Flight Simulator is all about.

A quick test flight for the PC:

- Boot the disk as you would any system master disk.
- When the instrument panel and startup menu appear, press the *A* key if you have a color monitor, *B* if you have a monochrome monitor, or *C* if you have an RGB monitor.
- On the second startup menu, press *B* to continue this test flight (pressing *A* will start an automatic demo – reboot to get out of it).
- On the third startup menu, press *B* to select the PC keyboard. You'll be on Meigs Field in Chicago (a small airport on a peninsula, surrounded by Lake Michigan).
- Press Scroll Lock, then the left arrow (*4* on the numeric keypad) to look out the left side of the airplane. Notice the wing at the top of the three-dimensional display.
- Press Scroll Lock, then the down arrow, to look out the back of the plane. Notice the tail at the screen's center.
- Press Scroll Lock, then the up arrow, to return to a forward view.
- Press the down arrow four times in rapid succession (no more than 1/2 second between keypresses). This raises the elevator a bit.
- Press the F2 function key. This increases throttle to full so the plane starts rolling down the runway. The plane will take off by itself. You'll be able to see when you leave the ground.
- Once off the ground, press Scroll Lock, then the down arrow, to look out the back again.
- Press Scroll Lock, then the up arrow, for the front view. Watch the flight instruments. Airspeed, altimeter, and vertical velocity gauges will all show movement.
- Press the left arrow to start banking the plane. The horizon will tilt. Don't let the bank get too steep.
- After about 20 degrees of bank, press *5* in the center of the numeric keypad (not on the top row of keys) to neutralize the ailerons and keep the plane in its current bank.
- Press Esc. On the menu that appears, you can adjust flight parameters. Press the Enter key many times. The arrow will sequence through two pages of 40 adjustable parameters. After looking them over, press Esc again to get back into flight mode.
- Now press the right arrow six times, and wait about a minute without interfering with the controls.
- After a crash, Flight Simulator resets and returns you to your starting location.

Flight Instruments, Radios, and Visual Systems

Microsoft Flight Simulator has all the instruments and equipment required under FAA regulations (part 91.33) for day and night *Visual Flight Rules* (*VFR*) and day and night *Instrument Flight Rules* (*IFR*) under non-icing conditions.

When you start the Flight Simulator program, you will be in easy flight mode and auto-coordinated flight mode. You will fly in optimal conditions and use the primary instruments and controls.

The Three-Dimensional Display

The display screen is split horizontally into two sections. The upper section is a highly realistic, three-dimensional display of the view out your windshield. Through it you can see the runway, terrain, and horizon.

The visual effects of the Flight Simulator program are also realistic. On clear days the sky is blue. Cloudy days bring grey skies, unless you break out of the clouds and reach blue sky. As you fly through clouds, visibility is obscured.

Radio messages scroll across the top of the screen and provide airport and weather information. This information is transmitted by the Automatic Terminal Information Service (*ATIS*), which is available near major airports.

The Instrument Panel and Radio Stack

The lower section of the screen displays the instrument panel and *radio stack*. Instruments are arranged as they would be in nearly any aircraft. The style of these instruments varies from plane to plane. The most modern form of each is used in Flight Simulator.

The standardized instrument cluster:

The six primary flight instruments are grouped together in the *standardized instrument cluster* (see Reference Figure 1, at the back of this manual). In addition to the standardized instrument cluster, the instrument panel includes various instruments, indicators, and radios. You will use only a few of these on your first flight. Those that you will not use on your first flight are described in more detail in "Secondary Aircraft Controls."

The numbers accompanying the instrument and radio names correspond to the boldface numbers in the figure. The instruments (beginning from the left) are:

1. *Airspeed indicator.* Measures in *knots* the aircraft's speed through the air around it. The airspeed indicator is an air-pressure-activated gauge. It does not measure *ground speed.*
2. Attitude indicator, or *artificial horizon.* Shows the aircraft's pitch and bank attitudes.

   Pitch is the rotation of the plane about its lateral axis (nose-up or nose-down). Pitch is measured by the center bar of the attitude indicator. When the bar is aligned with the horizon, you are flying in straight and level flight. Horizontal markings near the center indicate nose-up and nose-down pitch angles.

   Bank is the rolling of a plane on its *longitudinal axis.* The bank indicator is the small arrow that points to the 10-, 20-, 30-, 60- and 90-degree markings at the edge of the attitude indicator. When the arrow points to the 0-degree bank mark, you are in straight and level flight. The arrow always points to the top of the gauge. The bank marks rotate around the edge of the instrument.
3. *Altimeter.* Measures altitude in feet above sea level. The gauge is operated by atmospheric pressure. The altimeter is read like a clock with 10 divisions instead of 12. The large hand indicates hundreds of feet above sea level (with increments of 20 feet), and the small hand indicates thousands. The small arrow near the outside of the gauge indicates tens of thousands of feet.

   Sea level is not the same as ground level. At an airport at a 750-foot elevation, the altimeter registers 750 feet while the plane is sitting on the ground.

   Barometric pressure changes caused by changes in the weather can cause errors in altitude readings. Pilots must often calibrate this gauge to the barometric pressure of the airspace through which they are flying. (At altitudes above 17,999 feet, you must calibrate to "standard pressure," which is 29.92 inches of mercury.)

The small knob on the gauge is used to set the barometric pressure, which is noted in the small square window. Flight Simulator's altimeter can be adjusted for barometric pressure by pressing the *A* key on the PC or Shift *A* on the PCjr. The letter "A" on the altimeter's adjustment knob refers to the key.

4. Turn coordinator. Measures turn rate and coordination. No numerical value appears on this gauge. Instead, a single turn rate position is marked by the turn indicator (the small airplane symbol on the gauge). When the gauge aligns with the "L" (Left) or "R" (Right) indicators, a two-minute turn results. This means that the plane will complete a 360-degree turn in two minutes. The turn coordinator, unlike the turn indicator gauge used in some planes, uses a 35-degree *canted gyroscope* that reflects both bank and heading changes. Pitch, however, has no effect on the gauge. The turn indicator is also useful for timed turns.

   The ball in the turn coordinator indicates slip/skid attitude, or aircraft coordination. When the ball is centered, the aircraft's longitudinal axis is parallel to the direction of flight and the flight is "coordinated." Coordinated turns are the safest turns. Some maneuvers (notably slips and skids) are not coordinated. See "Advanced Flight Techniques" for more information about slips and skids.

5. *Heading indicator* or directional gyro. Notes the direction of flight. The heading indicator is a gyroscopically controlled compass that, unlike a magnetic compass, has no inherent direction-seeking characteristics. It is much more responsive and steady than the magnetic compass. Using the magnetic compass, calibrate the heading indicator before each flight and a few times an hour while in flight. The gauge knob is used to make the adjustment.

   Flight Simulator's heading indicator can be set to the magnetic compass direction by pressing the *D* key on the PC and Shift *D* on the PCjr. A "D" is marked on the heading indicator's adjustment knob as a reference to that key. Always be sure that the magnetic compass has "settled down" after a turn or climb-to-level transition to avoid setting a wrong heading.

6. Vertical speed or *rate of climb indicator*. Measures *rate of climb* or descent in hundreds of feet per minute. This gauge operates on air pressure changes and is not adversely affected by absolute barometric pressure. It lags slightly behind the aircraft's responses; avoid "chasing" (flying in direct response to) the vertical speed indicator to establish a constant altitude.

Other flight instruments and indicators:

7. Magnetic compass. A standard magnetic compass.
8. *Omni-Bearing Indicator* (*OBI*), with *glideslope*. A landing approach and general navigation instrument that is used with the NAV 1 (Navigation) radio to tune into VOR (Very high frequency Omni-directional Range) radio beacons.
9. Same as above, but used with the NAV 2 radio.
10. Clock. A standard digital clock that runs in real time and measures hours, minutes, and seconds. Under 1982 FAA regulations, a digital presentation qualifies for IFR flight in lieu of an analog sweep second hand clock. The Flight Simulator clock is very accurate. (For details on setting the time, see "Selecting the Time of Day.")
11. Gear indicator. Indicates whether the landing gear is lowered or raised.
12. Lights indicator. Indicates whether the running lights and instrument lights are on. Running and instrument lights should be turned on at night so the plane is visible to other air traffic and ground observers and so you can see the instrument panel.
13. Magnetos indicator. Indicates if the left and right *magnetos* (engine ignition coils) are on or off. The magnetos can be switched on individually (left or right) or simultaneously (both). The magnetos indicator also acts as a carburetor mixture lean indicator for engine shutdown.
14. Carburetor heat indicator. Indicates if the carburetor heat is on.
15. O (Outer), M (Middle), and I (Inner) marker lights. Tell when your aircraft is over the outer, middle, or inner marker beacons during instrument approaches.

Engine monitoring instruments:

16. Left wing fuel tank gauge.
17. Right wing fuel tank gauge.
18. Oil temperature gauge.
19. Oil pressure gauge.
20. *Tachometer.*

Radios:

21. *NAV1* radio. A NAV radio is a 200-channel radio used to tune in and identify VOR (Very high frequency Omnidirectional Range) navigation aids. It also receives ILS (*Instrument Landing System*) frequencies.

    The NAV radios receive frequencies between 108.00 and 117.95 MHz, with 50 kHz separations. *VORs* are radio stations that transmit an omnidirectional synchronization signal. This synchronization signal is followed by a circular sweeping directional signal. The NAV receiver in your aircraft decodes these signals to determine the angle or "radial" of the station you are on. Radials are directional beams that radiate from the VOR station. The NAV receiver also controls the Omni-Bearing Indicator, which you can use to guide your plane along radials as you move toward or away from VOR stations. For instruction on instrument approach and flying (using the ILS localizer and glideslope), consult a training manual, such as *Instrument Flying* by Richard L. Taylor.

22. NAV2 radio (see above). Two NAV radios are provided. Two VOR stations can be tuned simultaneously so you can cross-check your position.

23. *DME.* This works in conjunction with the NAV1 radio to tell you how many nautical miles you are from the tuned-in VOR.

24. *COM* radio. The COM radio is a 360-channel transceiver that receives and transmits at frequencies between 118.00 and 135.95 MHz, with 50 kHz separations. The Flight Simulator COM radio is used as a receiver only. Airport, weather, and approach information can be received by tuning in ATIS at most major airports. For more information on using the COM radio, see "Secondary Aircraft Controls."

25. *Transponder.* The transponder is a radio that is used to identify your aircraft on Air Traffic Control (*ATC*) radar.

Note The IBM keyboards, unlike real control panels, do not give you the feel of moving the controls. To compensate, the Flight Simulator instrument panel includes position indicators for the controls.

Control position indicators:

26. Aileron position indicator. Indicates the position of the ailerons. The *ailerons* are *airfoils* on the trailing edge of the wing that control the movement of the plane on its longitudinal axis. When the arrow on the indicator is aligned with the center mark, the ailerons are centered. When the arrow points to the right of the center mark, right aileron is applied; when the arrow points to the left, left aileron is applied.
27. Elevator position indicator. Indicates the position of the elevators. *Elevators* are airfoils that control the movement of the plane on its lateral axis, moving the plane (nose) up and down. When the indicator arrow is aligned with the center mark, the elevators are centered. When it is above the center mark, the elevators are raised; when below, the elevators are lowered.
28. Rudder position indicator. Indicates the position of the rudder. The *rudder* controls the rotation of the plane about its vertical axis (left or right rotation). The rudder position indicator works just like the aileron position indicator. In *auto-coordinated* mode (one of the two modes you are in when you begin the program), the aileron and rudder position indicators work as a unit.
29. Throttle position indicator. Indicates how much throttle is applied. The throttle has 32 settings.
30. Elevator trim indicator. Indicates elevator trim setting, which is detailed in "Aircraft Controls for the PCjr" and "Aircraft Controls for the PC."
31. Flap position indicator. Shows the position of the flaps.
32. Mouse control of view select. Enables radar view.

Aircraft Controls for the PCjr

Microsoft Flight Simulator, like a real aircraft, has many controls: engine function controls, flight controls, a navigation radio, and a communications radio. All the controls are necessary for safe, efficient flight, but only the primary flight controls are needed to get you flying.

The primary flight controls cover all controls for easy flight – the ailerons, elevators, rudder, and throttle. Simulation controls are features of Flight Simulator so you can look outside your window, use radar, or pause. To navigate and control the engine, use the secondary flight controls.

Note This section describes the controls for the PCjr. If you have a PC, skip to the next chapter, "Aircraft Controls for the PC."

Primary Flight Controls

The primary flight controls include the *control yoke* (a steering-wheel-like control on most planes, a control stick on others), the rudder pedals, and the throttle. The control yoke is arranged in a diamond-shaped pattern (a "control diamond") on the computer keyboard; the rudder pedals are to the right and left below it, as in a real aircraft. The PCjr control yoke is located on the three-by-three block of keys, with the G key as the center key (R-T-Y; F-G-H; V-B-N). The PCjr throttle is adjusted by the [and] keys.

For a summary of all the Flight Simulator key positions for the PCjr, see Reference Figure 2, at the back of this manual. If you are unfamiliar with the parts of an airplane, see that same figure.

Note If you have IBM joysticks, you may want to use one for the control yoke and one for the throttle. For more information, see "Joystick Use and Techniques" in this section.

The Control Yoke and Rudder

The yoke operates the ailerons and elevators, which are controlled to guide the plane on its course. The ailerons, on the trailing edges of the wings, control the rotation of the plane about its longitudinal axis. Ailerons control bank, or roll, of a plane (see Figure 2).

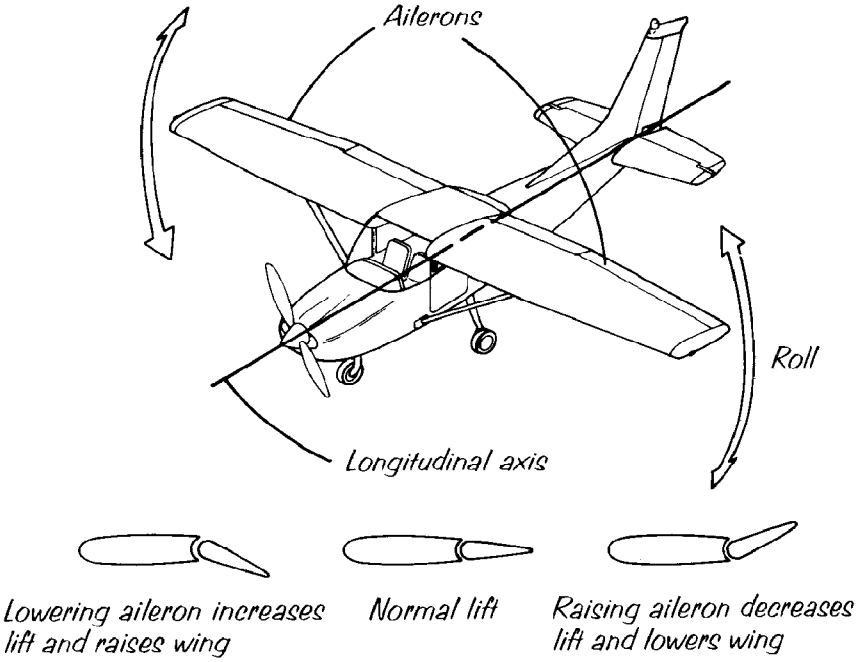

Figure 2. Ailerons

The elevators, on the trailing edge of the *horizontal stabilizer* (the "rear wings"), control the movement of the plane on its lateral axis, moving the nose of the plane up or down (see Figure 3).

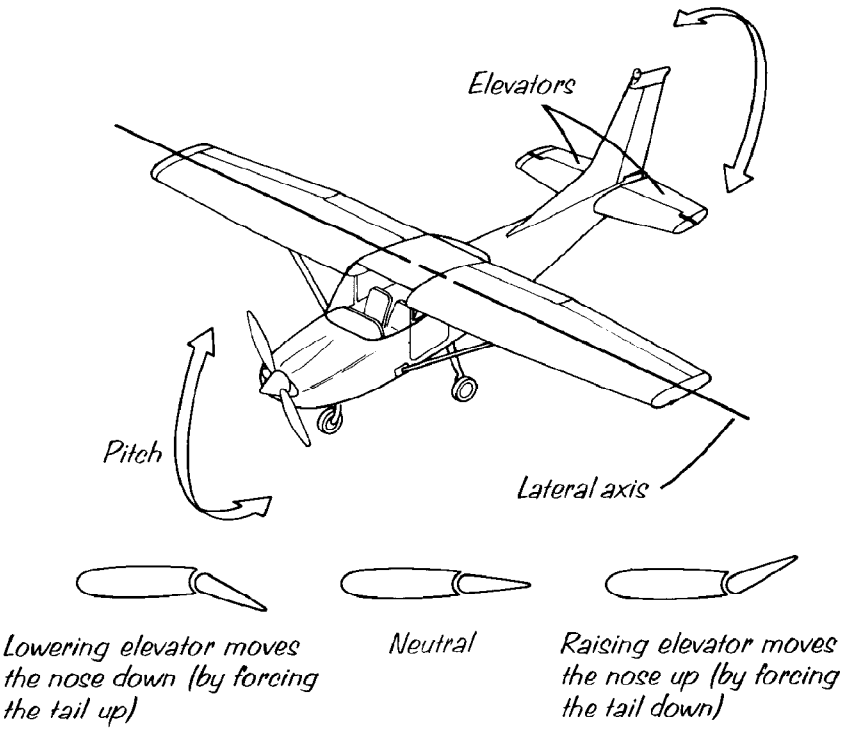

Figure 3. Elevators

The rudder, which is located on the *vertical stabilizer* of the plane, moves the plane on its vertical axis (see Figure 4).

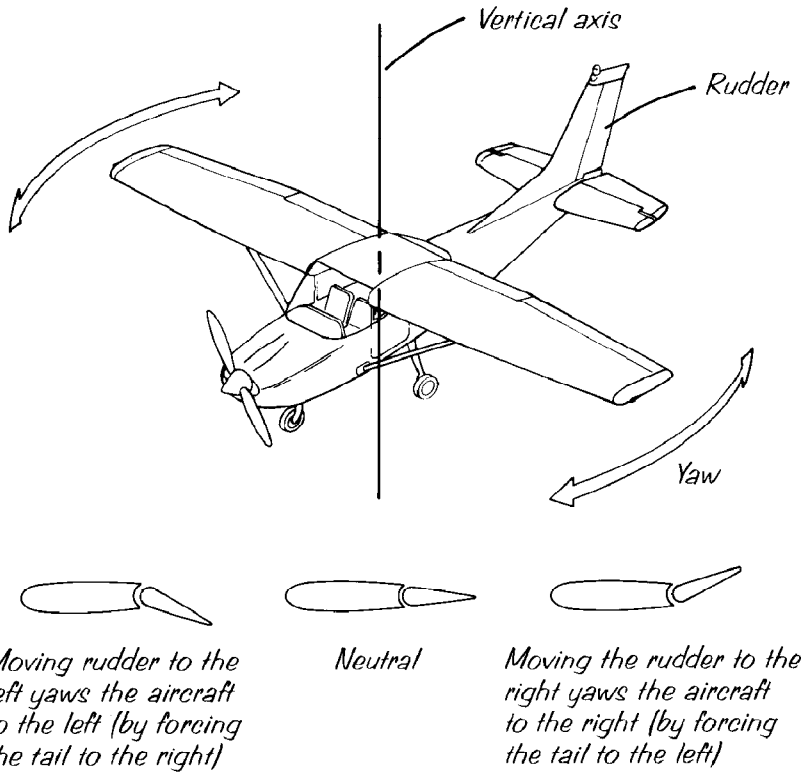

Figure 4. Rudder

Figure 5 shows the control yoke and rudder keys. In auto-coordinated flight mode, the rudder and ailerons are linked. Adjusting one also adjusts the other.

To bank and center the plane:

The ailerons are controlled by the F and H keys of the control yoke. Pressing the F key applies left aileron (yoke left) and lets you bank left. Pressing the H key banks you right. Pressing the G key centers the ailerons.

To raise and lower the nose:

The elevators are controlled by the B and T keys of the control yoke. Pressing the B key (yoke back) moves the elevators up. When you are flying, this lifts the nose of the airplane. Pressing the T key (yoke forward) moves the elevators down, lowering the nose. Rapid keypresses make broad, quick adjustments in elevator position. Pressing the elevator keys slowly, with at least one-quarter second between each press, moves the elevators by one-eighth of their normal adjustment for fine elevator control.

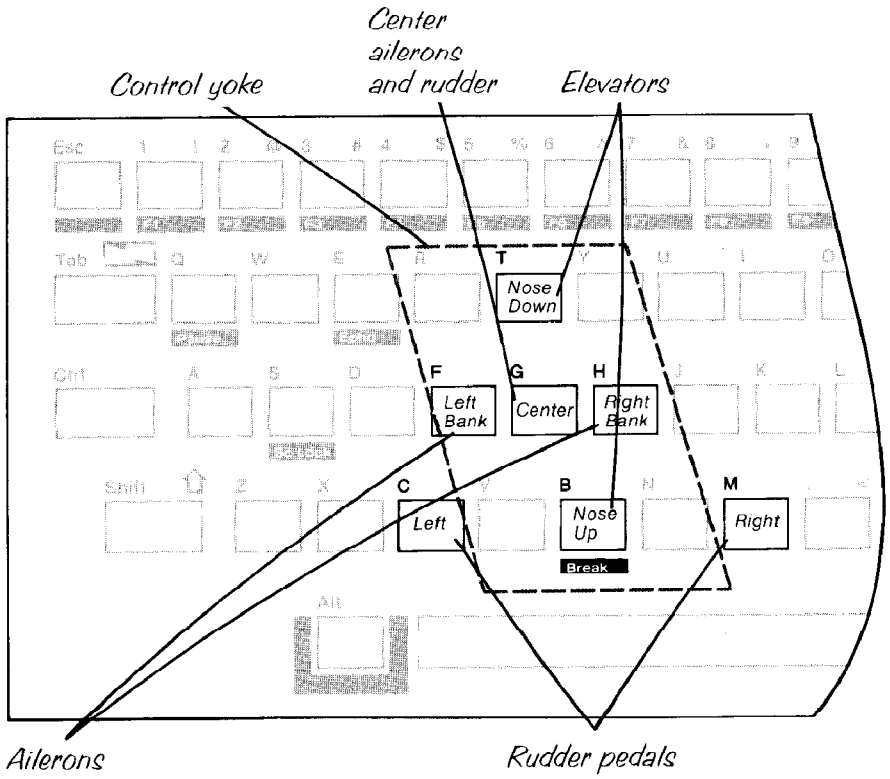

Figure 5. Control Yoke and Rudder Pedals for the PCjr

Experiment with the ailerons and elevators. Notice how the changes in position are shown on the aileron and elevator position indicators.

The C and M keys adjacent to the control yoke operate the rudder. These keys are marked as rudder keys on the keyboard overlay. Pressing the C key *yaws* the plane left. Pressing the M key yaws the plane right. Pressing the G key centers the rudder. The rudder is also used to steer the nose-wheel when the plane is on the ground.

Experiment with the rudder. See how both the aileron and rudder position indicators move as you move the rudder. Nothing else will happen, because you must be moving to ground-steer the plane.

The Throttle

The right and left bracket keys ([and]) are the throttle lever (see Figure 6). Think of these symbols as chopped-off left and right arrows meaning less and more throttle, respectively. There are 32 throttle positions (or notches). The [and] keys decrease and increase the throttle one notch per press.

The / key is the "full or cut" key and can precede a] or [press to indicate full or cut throttle. The / key is a convenience that lets you go from idle to full throttle (when beginning a takeoff, for example) without having to press the] key 31 times. Keep in mind that this is just a convenience. It is a bad practice to quickly move the throttle from idle to full as it can bog down and stall the engine. Slow, smooth throttle movements are always preferable.

The throttle position indicator on the panel shows the throttle setting. The keyboard overlay identifies the throttle keys.

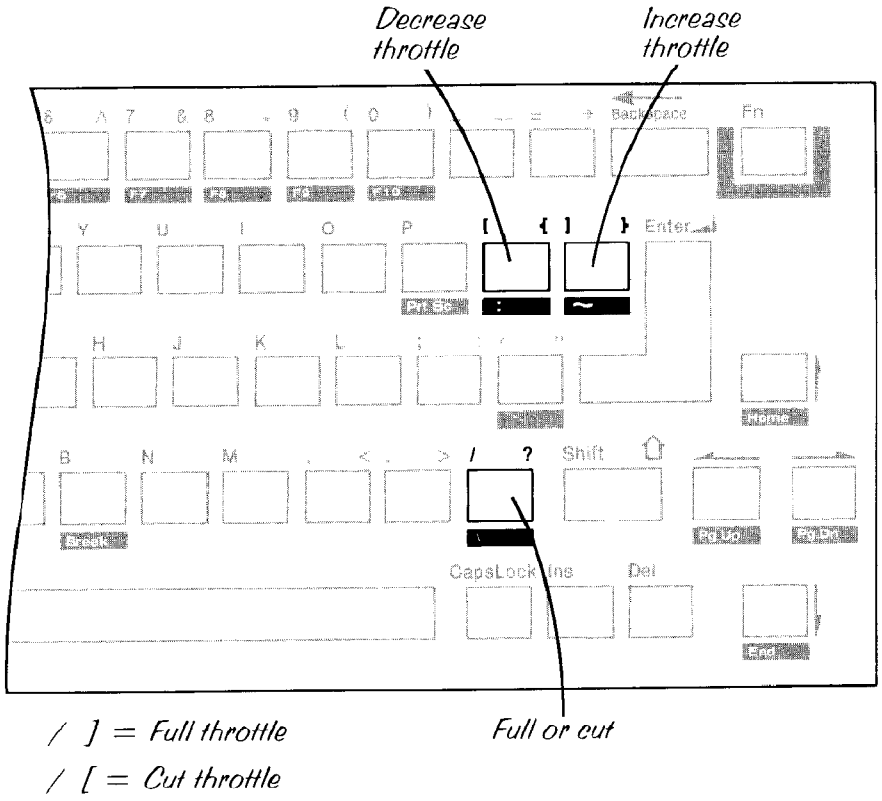

Figure 6. Throttle Controls for the PCjr

Simulation Controls

Several keys on the main keyboard control flight systems, visual systems, and the simulation itself. Those you will use during your first flight are described in this section.

To view your surroundings:

When you fly according to Visual Flight Rules, you will need to look around frequently to observe traffic, weather, and obstacles. The view selector lets you choose from nine viewing directions. To use the view selector, press the View key (5) and then any one of the keys on the control yoke (see Figure 7). Do not press the keys simultaneously.

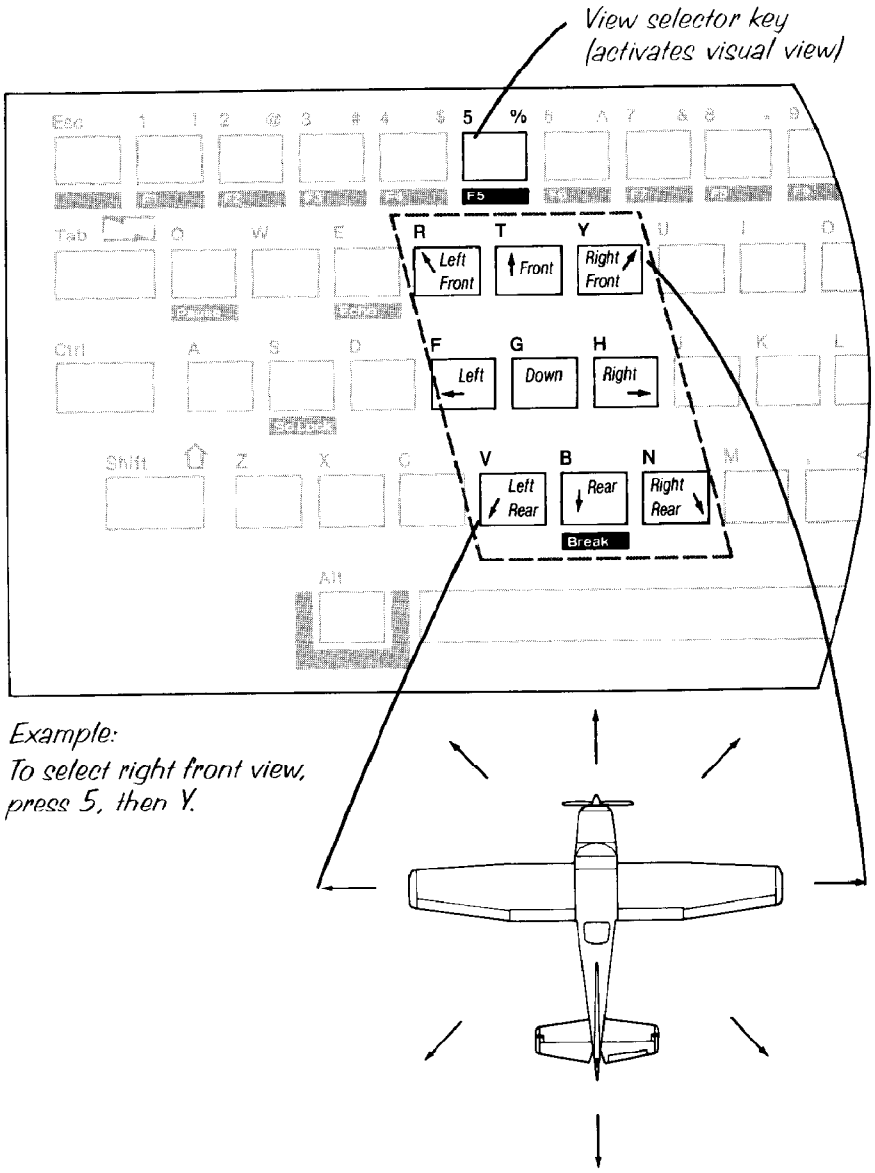

Figure 7. View Selector Controls for the PCjr

The keys bear a logical relationship to the selected view. For example, pressing *5* and the *B* key displays the view you would see if you could look directly behind you (notice the tail). Pressing the *5* key and the *Y* key instead displays the right front view (notice the front part of the wing). Pressing *5* and the *G* key displays the downward view (notice the landing wheel strut). You may also adjust your selected view up or down, by pressing the Backspace or Enter key respectively.

To use radar:

Radar gives you a top-down view with an adjustable range or zoom. This gives you an overview of the area in which you are flying. A small symbol indicates your position. You can also use radar view to guide yourself around airports and to navigate. The image it presents is unrealistically accurate and is more like a map display.

To select radar view, press the Radar key (*4*). Press the + or − keys (marked More and Less on the keyboard overlay) at the top of the main keyboard to zoom in and out of the radar's sampling range. To return to the three-dimensional display, press the *5* key.

To select a new viewing direction after switching from radar to three-dimensional view, press the *5* key again and a view direction key.

The Pause key (Q, P, or Shift P) suspends simulation. Pressing the Pause key a second time resumes simulation where you left off. You will find this feature particularly helpful for reading ahead in the manual if you lose control of your plane.

Secondary Aircraft Controls

The primary flight controls are the only controls needed to fly the plane in easy flight mode (the mode you are in when you begin the program). The secondary controls are used to navigate, control the engine, and control the simulator itself. Their positions on the panel and functions are described in previous sections. A description of how to use these follows. If this is your first flight, you may want to return to this section later.

Flaps

Flaps are movable panels on the inboard trailing edges of the wings. They are hinged so they can be extended downward into the flow of air beneath the wings to increase lift (upward force) and *drag* (rearward pull). Their primary purpose is to permit a slower airspeed and steeper angle of descent during a landing approach. They can also be used to shorten takeoff distance or decrease stall speed on landing approach.

To slow your plane for landing:

The Y and N keys (marked as flaps on the keyboard overlay) raise and lower the flaps one notch per press (see Figure 8). Remember these keys as the upper right and lower right keys of the control yoke. Watch the flaps position indicator, not the keyboard, while pressing these keys.

Extending and retracting the flaps affects the plane's performance considerably. Lowering the flaps increases both lift and drag. This increases glide angle, which is particularly useful if you are flying too high on an approach and want to increase your rate of descent. Airspeed can be reduced by extending the flaps.

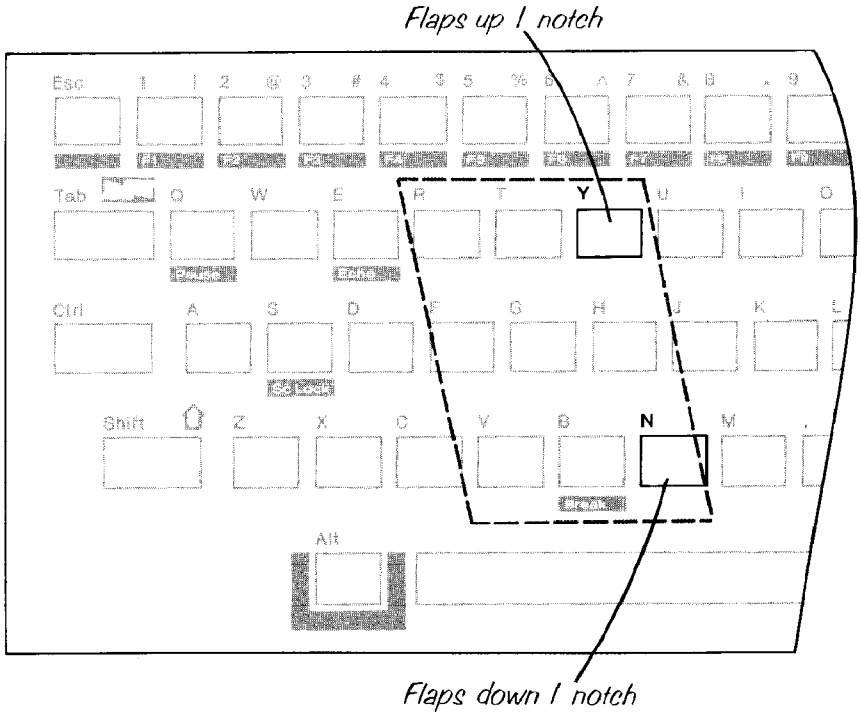

Figure 8. Flap Controls for the PCjr

Elevator Trim

The control yoke is directly connected to the airfoils it controls. Different flight attitudes put different pressure on the airfoils. These variations also change the pressure on the yoke. The pilot must counteract these forces to keep the airfoils in their proper positions. Applying steady pressure on the yoke for hours would be fatiguing. *Trim* is used to counteract these forces and relieve the pilot from applying constant pressure on the yoke.

To counteract forces on the yoke:

Flight Simulator provides elevator trim controls. The R and V keys on the contol yoke control elevator trim. These keys are marked Trim on the keyboard overlay. Pressing the *R* key adjusts the trim downward. Pressing the *V* key adjusts the trim upward. The elevator trim position indicator shows elevator trim position, with the "U" representing the up position and the "D" representing the down position (see Figure 9). Remember these keys as the upper left and lower left keys of the control yoke.

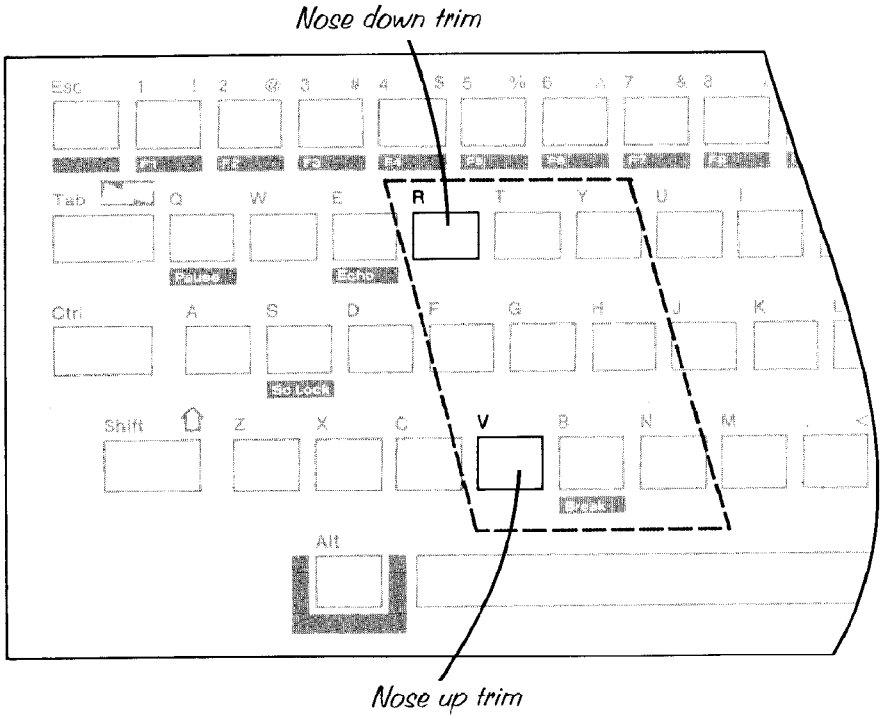

Figure 9. Elevator Trim Controls for the PCjr

Carburetor Heat

The Heat key (Shift H) is the carburetor heat toggle switch. The carburetor heat indicator on the instrument panel shows whether carburetor heat is on or off.

Carburetor heat is used to preclude icing or clear ice that has already formed in the carburetor. Apply carburetor heat for a few seconds on landing approach to avoid ice-caused engine failure.

Magneto Switch and Mixture Full Lean Control

The Magneto key (Shift M) is the magneto switch. After you press the Shift *M* key, enter one of the following numbers to indicate magneto setting.

Number	***Result***	
1	OFF	Magnetos off
2	L	Left magneto on
3	R	Right magneto on
4	B	Both magnetos on
5	ST	Start engine, then both magnetos on
0	LN	Mixture full lean (engine turn-off)

Lights

The Lights key (Shift L) turns on the running and instrument lights. *Running lights* are lights on the tips of each wing – red on the pilot's left, green on the right – that help others identify your heading. Instrument panel lights illuminate individual instruments on the instrument panel, so you can see them at night. You must turn on the running and instrument panel lights for night flight. It's not advisable to fly with your lights on during the day. If you do, when night arrives you may find that a bulb on an important instrument has burned out. Bulbs are replaced during refueling and servicing stops.

Navigation Radio

The NAV radio is an important navigational aid. It is used to tune in VOR radio beacons, so you can fly toward or away from them.

To tune into VOR beacons:

Two NAV radios are provided so you can tune in two VOR beacons at once. This is useful for doing cross-checks of your position. You must set the NAV radio to the VOR frequency to receive the appropriate signal. On a real aircraft, two knobs are used to set the frequency. One sets the full megahertz frequencies (121, 122, 123, etc.), and the other sets the fractional frequencies in 50 kHz increments (.00, .05, .10, etc.). Many new radios are 720-channel models with 25 kHz separations, but none of these intermediate frequencies are implemented on Flight Simulator.

To set the NAV radio to a particular frequency, press the NAV key (Shift *N*), followed by the radio number (*1* for NAV1 and *2* for NAV2). Then press the + or − keys to advance or move back the current setting until you reach the desired MHz frequency. To set the fractional frequency (e.g., .00, .05, .10, etc.), press the Shift *N* key twice, in rapid succession, then press either the + or − key until you reach the appropriate setting. Pressing the radio number after the Shift N key is only necessary if you want to tune a NAV radio other than the one you most recently tuned.

For example, to advance from 121 to 126 MHz, press Shift *N* + + + + +. To advance from .35 to .55, press Shift *N* Shift *N* + + + +. For more information on using the NAV radio, see "Navigational Aids."

The NAV1 radio is also used to tune in ILS localizer and glideslope. For more information on instrument flying, see "Advanced Flight Techniques." For detailed information, consult a flight training manual.

Omni-Bearing Indicator

The OBI is used with the NAV radio to tune into VOR (Very high frequency Omnidirectional Range) radio stations. VORs are radio stations that transmit an omnidirectional synchronization signal followed by a circular sweeping directional signal. The NAV receiver in the aircraft decodes these signals to determine what angle or "radial" from the station you are on. Radials can be thought of as directional beams radiating outward from the VOR station like spokes of a wheel.

To navigate to and from VORs:

The OBI or VOR indicator is a panel-mounted instrument that lets you determine what VOR radial your plane is currently on. It also helps you fly along radials toward or away from the VOR station.

Two OBIs are provided. The top OBI (Reference Figure 1, item 8) corresponds to the NAV1 radio. The bottom OBI (item 9) corresponds to the NAV2 radio.

To set the OBI, press the VOR key (Shift *V*). The letter "V"on the knob of the OBI indicator refers to the Shift V key. Next, if you want to adjust an OBI other than the one you most recently adjusted, press number *1* for the top OBI and *2* for the bottom OBI. Then, press + or − keys as needed to select the right course and reciprocal course readings. Each keypress adjusts the course selector by two degrees. Holding the + key down rapidly sequences through the degree settings.

Communications Radio

Use the COM radio to tune into ATIS for weather, airport, and approach information. The charts at the back of this manual note the ATIS frequencies for each airport where this service is available. The same procedure that is used to set NAV radio frequencies is used to set the COM radio, except that you press the COM key (Shift *C*) instead of the Shift N key.

Transponder

On occasion, Air Traffic Control (ATC) will ask you to transmit a four-digit code or "squawk." The message from ATC will scroll across the top of your screen. ATC will use the number your transponder transmits to track you on its radar screen.

To help ATC track you:

To set the transponder, choose the digit you want to change. To change the left-most digit, press the Transponder key (Shift *T*), then press the + or − key on the main keyboard as necessary to select the appropriate digit. To set the second digit, press Shift *T* twice, in rapid succession, followed by the appropriate + or − keypress. Press Shift *T* three or four times to set the third or fourth digits, respectively.

Altimeter

To set the altimeter to the current barometric pressure, press the Altimeter key (Shift *A*). The altitude reading may change when you press this key. We recommend that you do this several times each hour in reality mode to ensure accurate altimeter readings.

The letter "A" on the altimeter's adjustment knob refers to the Shift A key.

Heading Indicator (Directional Gyro)

Pressing the Directional Gyro key (Shift *D*) sets the heading indicator to the same reading as the magnetic compass. (The magnetic compass does not drift with time as the heading indicator does, and it will always show a correct reading once it has "settled down" after a turn.) Always be sure the magnetic compass has settled down to avoid setting an incorrect direction. The letter "D" on the heading indicator's adjustment knob references the Shift D key.

Landing Gear

The Landing Gear key (Shift G) raises and lowers the *landing gear.* The gear indicator on the panel shows the current status of the landing gear. You do not have to raise the landing gear after takeoff. If you do raise it, however, be sure to lower it on landing approach. Flying with the landing gear down increases drag.

Brakes

The Brakes key (.) applies the brakes. Each keypress reduces your speed by a few knots. Several presses are usually necessary to bring the plane to a complete stop. Brakes are used only on the ground.

Keyboard Techniques

Keypresses

Holding down most alphanumeric keys automatically generates many keypresses (at the rate of 12 per second). Holding down the elevator, aileron, rudder, or throttle control keys results in multiple notch adjustments. For example, alternately holding down the left and right aileron keys will gently rock the plane from side to side (when doing "Dutch Rolls," for instance). The . key (the brakes), if held down, will eventually bring a taxiing plane to a stop.

However, toggle keys, such as the Shift G key (which raises and lowers the landing gear), should not be held down. Doing so will repeatedly switch between the two settings.

The PCjr keyboard can only accept keypresses at about the rate a "fast typist" would type text. Avoid typing too quickly or pressing two keys simultaneously.

Finger Positioning

Finger positioning for operating the controls located in the control diamond is not the same as that used on an alphanumeric keypad. You will find it easy to operate these controls if you follow the "ten-key-by-touch" system, used by many people to operate adding machines and calculators.

Place the middle finger of your right hand on the *G* key on the keyboard. Then place your index and ring fingers on the *F* and *H* keys. To control the rudder pedals, use your thumb and little finger to operate the *C* and *M* keys.

Using Joysticks

You can control Flight Simulator ailerons, elevators, and throttle through the keyboard or through joysticks. To use joysticks, you will need one or two joysticks with buttons. The built-in joystick circuitry supports two joysticks designated as Joystick A and Joystick B. With Flight Simulator, Joystick A is used to control ailerons and elevators, and Joystick B is used to control the throttle.

IBM joysticks are ideal for use with the Flight Simulator. One or two of them may be plugged into the PCjr's joystick sockets, located at the back of the PCjr.

Setting up the Joysticks

Joysticks are either self-centering (the stick returns to the center position when released) or non-centering. Ailerons can be controlled with either a non-centering or self-centering joystick, as you prefer.

Note Only non-centering joysticks can be used to control the elevators and the throttle.

The IBM joysticks used with the PCjr have mechanical switching levers to enable or disable the self-centering springs. These switches are usually on the underside of the joystick case. The ideal setup for Flight Simulator joystick control is:

Ailerons (Joystick A, X-movement) = self-centering

Elevators (Joystick A, Y-movement) = non-centering

Throttle (Joystick B, Y-movement) = non-centering

Installing and Turning on the Joysticks

To install joysticks:

- Turn the computer off, and plug in the joysticks.
- Turn the computer on, and load Flight Simulator according to the instructions for "How to Load Flight Simulator."
- Enter the editor by pressing Esc, and press Enter to move to the Joystick parameter on the second edit page. (For details, see the chapter entitled "The Editor.")
- For the Joystick parameter, enter a "1" to turn on just Joystick A, or enter a "2" to turn on both joysticks (A and B).
- Return to flight mode by pressing Esc.

Joystick A can now be used to control the ailerons and the elevators (and the rudder in auto-coordinated mode). Sideways movement (on the X axis) controls ailerons and roll, and forward and backward movement (on the Y axis) controls elevators and nose up and down. (See Figure 10.) Slowly move the stick through its complete X and Y range, watching the elevator and aileron (and auto-coordinated rudder) indicators move. The movement may be jumpy, and pushing the stick in a specific direction may not move the ailerons or elevators in that direction, but calibration will solve these problems.

If you have two joysticks and entered "2" as the Joystick parameter, Joystick B can be used to control the throttle. Full forward provides full throttle, and full back reduces engine to an idle.

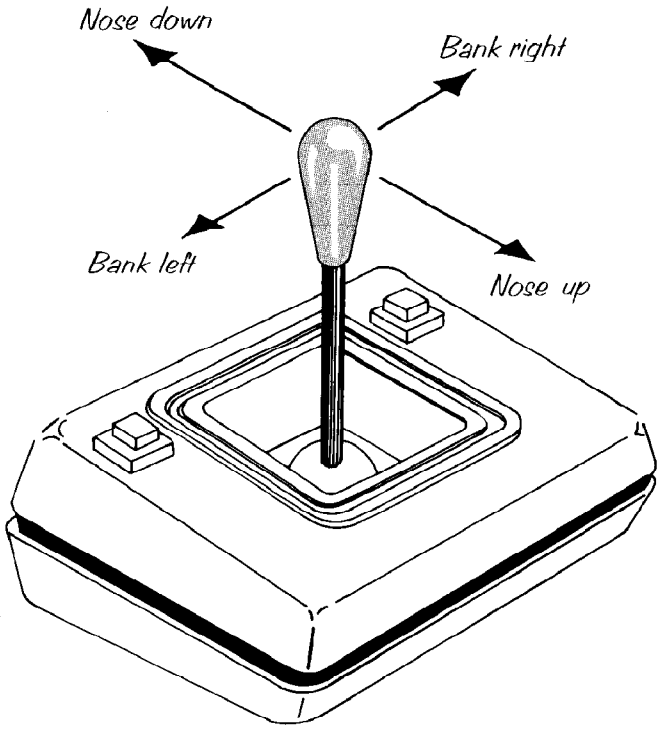

Figure 10. Joystick for the PCjr

Calibrating the Joysticks

After setting the Joystick parameter, you must calibrate the joysticks. Joysticks vary greatly from manufacturer to manufacturer. The range of numerical values generated also varies widely. The IBM joystick control circuitry calls for joysticks with 0 to 100K ohm resistance and linear response. Joysticks with these characteristics (including IBM's joysticks) work best with Flight Simulator.

The following calibration procedure will compensate for joystick tolerance and for joysticks that deviate from IBM's specification.

Important Do not enter the editor or press the Pause key during this process.

If you're using one joystick:

To calibrate the aileron and elevator joystick:

- Move Joystick A to its aileron and elevator center positions.
- Center the joystick's trim controls (if any).
- Press the *K* key.

If you're using two joysticks:

To calibrate the throttle joystick, as well as the aileron and elevator joystick:

- Move Joystick A to its aileron and elevator center positions.
- Center Joystick A's trim controls (if any).
- Make sure that Joystick B's trim controls (if any) are centered.
- Pull Joystick B all the way back.
- Press the *K* key.

When Joystick A's range is properly calibrated, the aileron indicator is set full left when the stick is fully left and full right when the stick is at its full right position. The elevator indicator is set full down when Joystick A is fully forward, and it is full up when the stick is fully back. Likewise, when Joystick A is in its center position, the ailerons and elevators are centered.

Make sure Joystick B is pulled all the way back. If it isn't, the plane will start accelerating.

During flight, you can use any trim controls on the joysticks to make minor adjustments and to keep the controls centered if the calibration drifts.

Using the Microsoft Mouse

You can use Microsoft Mouse with Flight Simulator. The mouse controls an on-screen pointer (icon) that resembles a hand and can be used to point at radio controls and instrument knobs.

Mouse Setup

To use the mouse, you must first boot the MS™-DOS system disk. After installing the mouse driver, you then boot Flight Simulator from MS-DOS, instead of as a stand-alone disk.

To set up Flight Simulator for using the mouse, follow the instructions listed below. You must have at least 128K of memory to use the mouse.

Always use drive A to install the mouse driver and boot Flight Simulator.

To install the mouse:

- Boot the MS-DOS disk.
- Remove the MS-DOS disk and insert the mouse disk with the MS-Mouse driver on it. (This is the disk that you received with your Microsoft Mouse. It should have the MOUSE.COM file on it).
- Type *mouse* and press Enter.

  Computer will respond with:

  Mouse driver installed

  If you get an error message that says:

  Bad command or file name

  you should check your mouse disk to make sure that the "MOUSE.COM" file is on there.
- Now that the mouse driver is installed, remove the mouse disk and place the Flight Simulator disk in drive A.
- Type *FS* and press Enter.

After the Flight Simulator disk boots up and after the initial monitor color and flight mode questions, you will be asked if you want to use the mouse. If you respond with Y, the "hand" pointer will appear on the screen. If the mouse driver was not installed in DOS, you will get a message saying that no driver was found. You can continue without mouse control, or reboot your MS-DOS disk and install the driver following the above procedure. (If you are familiar with DOS batch files, you may wish to set up a DOS batch file to run the mouse INSTALL program and Flight Simulator.)

To control instruments and indicators:

Microsoft Mouse can be used to adjust all instruments and indicators on your panel except elevators, rudder, flaps, and ailerons. You may want to set up Flight Simulator to use your joysticks for the control yoke and the mouse to control all other functions.

To control Flight Simulator with the mouse, move the pointer to the instrument or indicator you wish to change. Press the left button to decrease the current reading and the right button to increase it. For example, to change the NAV radio frequency to a lower number, point the hand at the digit you wish to change and press the left button. This same process applies to the transponder, COM radio, and clock. You can also reset the seconds to transform your clock into a stopwatch.

The VOR omni-bearing selector can be adjusted by positioning the hand on the "knob" (not the digits) on the VOR indicator and pressing the right or left button to increase or decrease heading. The altimeter and heading indicator can be set similarly by pointing at their "knobs" and pressing either button.

The mouse can also be used to toggle switches on or off. For example, to turn on the carb heat, point the hand at the CH indicator, and press either button. Pressing a button again will turn it off. For magnetos, the hand will cycle through the options once for every button press.

To adjust the throttle, position the mouse hand along the throttle indicator. Left decreases; right increases. The same applies for the trim. The mouse does not activate the flaps, ailerons, elevators, or rudder. To apply the brakes, position the hand along the rudder indicator and press either button.

To change the view:

The mouse can also be used to change the view selector. To change the view, position the mouse inside the heading indicator (directional gyro) dial. (See Figure 11.) To activate the front three views – straight ahead, right front, and left front – point the mouse to the corresponding digit in the top of the readout. To look directly left or right, point the mouse to the edge of the left and right wingtips on the plane outline. To look down, point the mouse to the middle of the outline. To activate the three rear views, point the mouse on the rear of the outline of the plane, as shown.

To activate the radar view, point the mouse to the small rectangular area located directly below the outline of the plane. Pressing either button activates the radar. To zoom in, press the right button. To zoom out, press the left button. The mouse must be pointing to the small rectangle while zooming in and out. To return to the out-the-window view, simply point the mouse to any view select area, as outlined above.

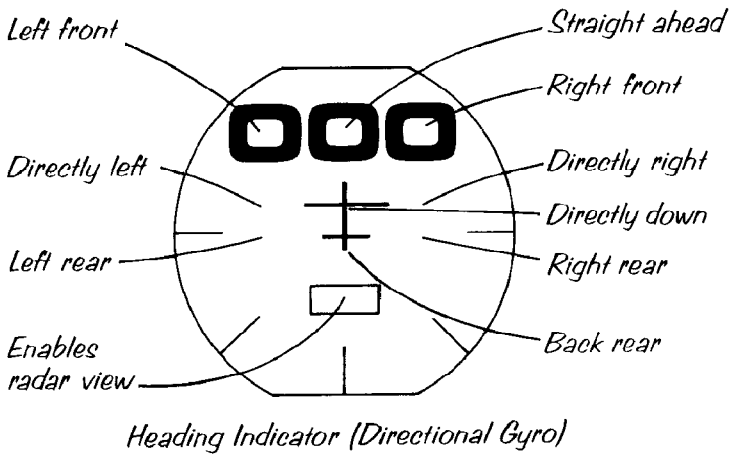

Figure 11. Mouse Control of View Select

Aircraft Controls for the PC

Microsoft Flight Simulator, like a real aircraft, has many controls: engine function controls, flight controls, a navigation radio, and a communications radio. All the controls are necessary for safe, efficient flight, but only the primary flight controls are needed to get you flying.

The primary flight controls cover all controls for easy flight – the ailerons, elevators, rudder, and throttle. Simulation controls are features of Flight Simulator so you can look outside your window, use radar, or pause. To navigate and control the engine, use the secondary flight controls.

Note This section describes the controls for the PC. If you have a PCjr, skip to the preceding chapter, "Aircraft Controls for the PCjr."

Primary Flight Controls

The primary flight controls include the *control yoke* (a steering-wheel-like control on most planes, a control stick on others), the rudder pedals, and the throttle. The control yoke is arranged in a diamond-shaped pattern (a "control diamond") on the computer keyboard; the rudder pedals are to the right and left below it, as in a real aircraft. The PC and PC XT control yoke is located on the numeric keypad, with the 5 key as the center. The throttle lever is the even-numbered row of the Function keypad.

For a summary of all the Flight Simulator key positions for the PC, see Reference Figure 3, at the back of this manual. If you are unfamiliar with the parts of an airplane, see that same figure.

Note If you have an IBM Game Control Adapter Card and joysticks, you may want to use one joystick for the control yoke and one for the throttle. For more information, see "Joystick Use and Techniques" in this section.

The Control Yoke and Rudder

The yoke operates the ailerons and elevators, which are controlled to guide the plane on its course. The ailerons, on the trailing edges of the wings, control the rotation of the plane about its longitudinal axis. Ailerons control bank, or roll, of a plane (see Figure 12).

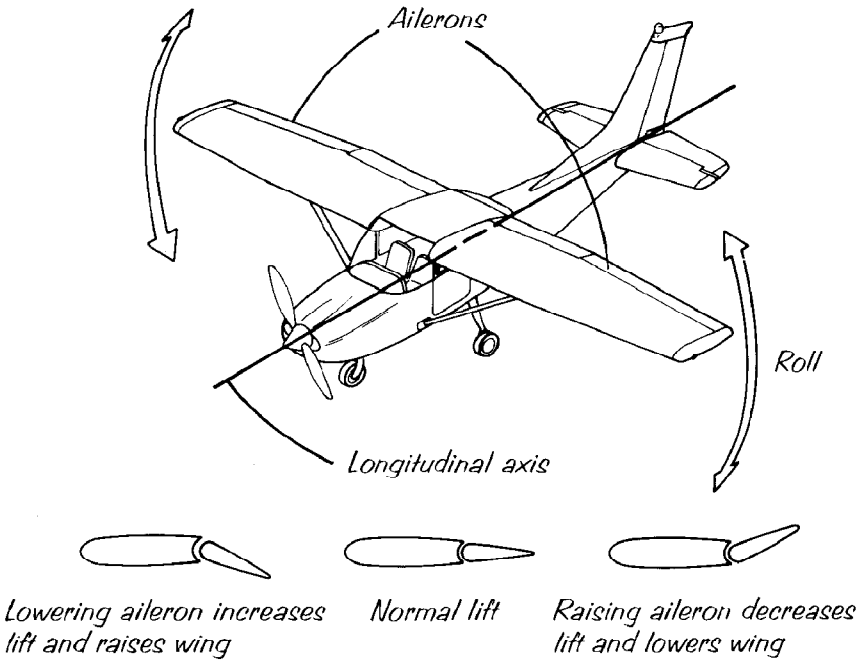

Figure 12. Ailerons

The elevators, on the trailing edge of the *horizontal stabilizer* (the "rear wings"), control the movement of the plane on its lateral axis, moving the nose of the plane up or down (see Figure 13).

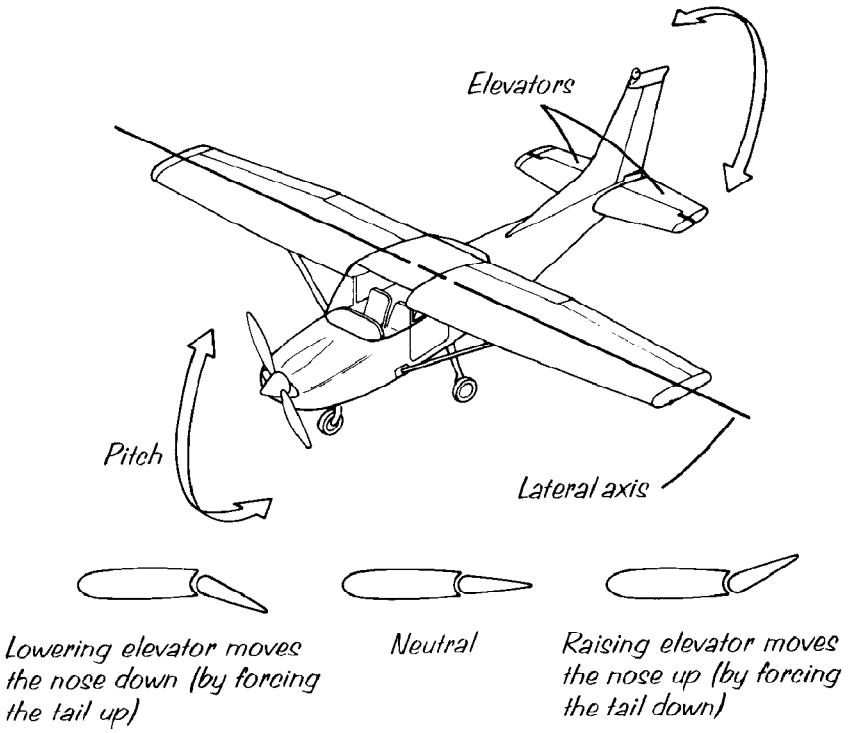

Figure 13. Elevators

The rudder, which is located on the *vertical stabilizer* of the plane, moves the plane on its vertical axis (see Figure 14).

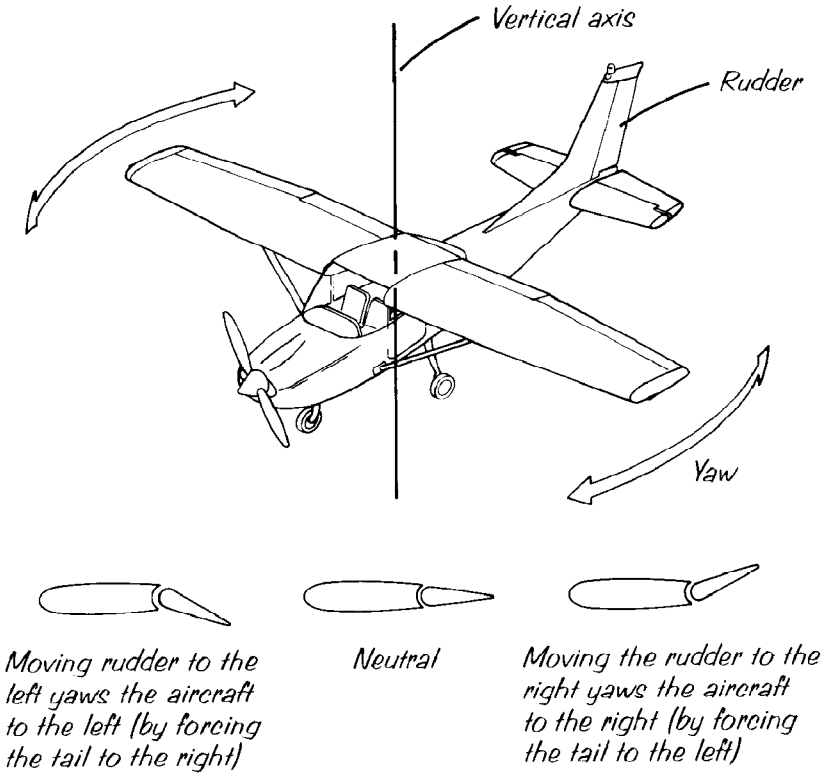

Figure 14. Rudder

Figure 15 shows the control yoke and rudder keys. In auto-coordinated flight mode, the rudder and ailerons are linked. Adjusting one also adjusts the other.

To bank and center the plane:

The ailerons are controlled by the 4 and 6 keys. Pressing the 4 key applies left aileron (yoke left) and lets you bank left. Pressing the 6 key (yoke right) banks you right. Pressing the 5 key centers the ailerons.

To raise and lower the nose:

The elevators are controlled by the 2 and 8 keys. Pressing the 2 key (yoke back) moves the elevators up. When you are flying, this lifts the nose of the airplane. Pressing the 8 key (yoke forward) moves the elevators down, lowering the nose. Rapid keypresses make broad, quick adjustments in elevator position. Pressing the elevator keys slowly, with at least one-quarter second between each press, moves the elevators by one-eighth of their normal adjustment for fine elevator control.

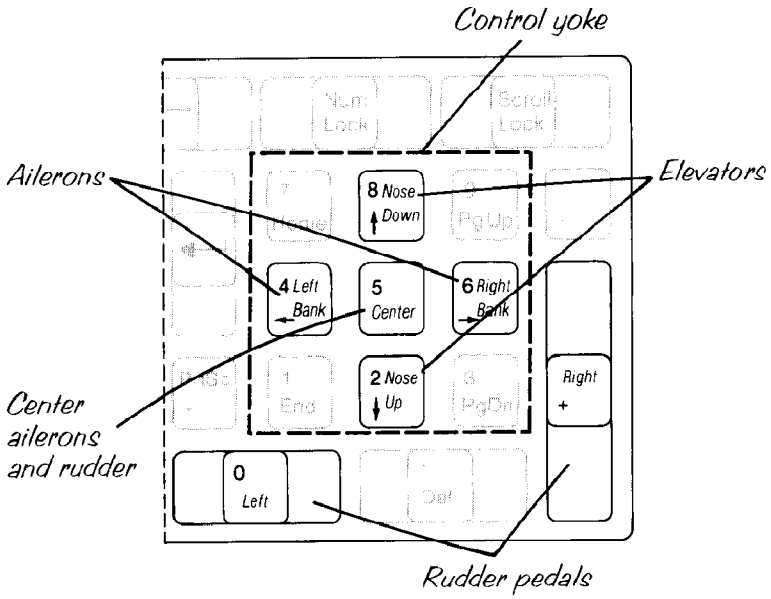

Figure 15. Control Yoke and Rudder Pedals for the PC

The Throttle

The *throttle* applies power. The vertical row of even-numbered Function keys (see Figure 16) forms the throttle lever. The throttle has 32 positions or "notches." Pressing the F2 key applies full throttle. Pressing the F10 key cuts the throttle. Pressing the F6 key (at the center of the throttle control row) advances the throttle one notch. Pressing the F4 key advances the throttle two notches. Pressing the F8 key decreases the throttle two notches.

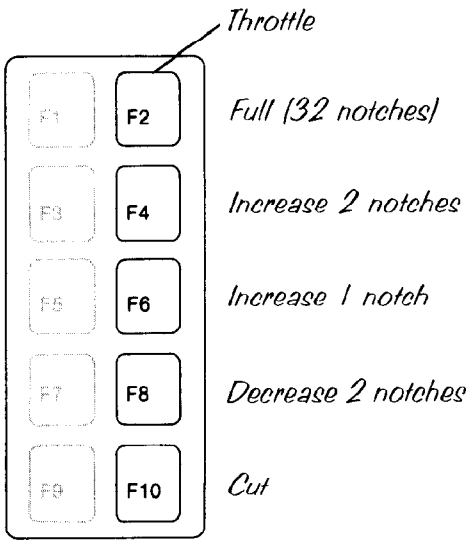

Figure 16. Throttle Controls for the PC

To move to full throttle you can use any of the three throttle-advance keys. For example, you could press the F2 key, which would automatically apply full throttle (the full 32 notches). This can cause the engine to flood and is bad flight practice. Or you could press the F6 key 31 times. Or you could press the F4 key 16 times. To decrease the throttle setting, use either the F10 key or the F8 key.

The throttle position indicator shows the throttle setting.